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THE HEART OF THE ANTARCTIC*

BY

EDWIN SWIFT BALCH

(Map facing p. 80)

In the annals of Polar discovery, no more brilliant exploit can be found than the Antarctic voyage of exploration under the command of Ernest H. Shackleton. Well conceived, well planned and well carried out, it has added to the realm of geography a vast amount of knowledge. The narrative of the journey is clear, accurate and temperate. The make-up of the book, paper, printing and illustrations, is a worthy setting for the narrative; altogether there can be nothing but praise for the efforts of the authors and the publishers.†

Shackleton was a member of Captain Scott's expedition in the *Discovery*, and in the year 1907, outlined a new expedition of his own. He succeeded in securing sufficient funds, principally through loans which he was to pay off on his return. It is pleasant to record that the British Government voted him £20,000 after his successful journey, a sum which enabled him to clear off all his debts. He was also knighted on King Edward's birthday, showing how England rewards its own Polar discoverers.

He purchased an old whaler, the *Nimrod*, which proved to be a fairly good boat. The expedition was carefully fitted out with food, clothing, general stores, and scientific instruments. A wooden hut was built and carried in pieces for re-erection in the Antarctic. A motor car, some dogs and Manchurian ponies were also taken along.

The shore party consisted of fifteen men:

Ernest Henry Shackleton, commander. Born 1874. Went to sea at the age of sixteen, became a lieutenant in the Royal Naval Reserve. In 1901, he joined the British National Antarctic expedition, and was a member of the "farthest south" party. Was defeated for Parliament in 1906.

J. B. Adams, lieutenant Royal Naval Reserve, meteorologist.

Bertram Armytage, in charge of ponies.

Sir Philip Brocklehurst, assistant geologist.

Professor T. W. Edgeworth David, F.R.S., geologist.

* "The Heart of the Antarctic." Being the story of the British Antarctic Expedition, 1907-1909, by E. H. Shackleton, C.V.O. 2 vols. With an Introduction by Hugh Robert Mill, D.Sc. An Account of the First Journey to the South Magnetic Pole by Professor T. W. Edgeworth David, F.R.S. J. B. Lippincott Company, Philadelphia, 1909. \$10.

† The Society is indebted to the J. B. Lippincott Company for permission to use the photographic illustrations reproduced here from Shackleton's book.

Bernard Day, electrician and motor expert.

Ernest Joyce, in charge of stores, dogs, sledges and zoological collections.

Dr. A. F. Mackay, surgeon.

Dr. Eric Marshall, surgeon and cartographer.

Douglas Mawson, mineralogist.

James Murray, biologist.

Raymond Priestley, geologist.

William Roberts, cook.

Frank Wild, in charge of provisions.

The *Nimrod* left Lyttelton, New Zealand, on Jan. 1, 1908. She was towed by the *Koonya* as far as the ice, following in the main the 180th meridian. Some heavy weather was encountered, the waves being estimated as rising to as much as 42 feet in height. Pushing down Ross Sea, the *Nimrod* reached the Great Ice Barrier on Jan. 23, in about 172° West. She followed the Barrier eastward, to nearly 162° West, when steep and rounded cliffs and sharp peaks, rising to a height of approximately 800 feet, were seen behind the ice. This is possibly new land, which was not noticed by Sir James C. Ross or Captain Scott. The ice beyond this point was so thick that further progress was impossible, and thus Shackleton was prevented from wintering on King Edward Land, as he had originally intended. He therefore turned the *Nimrod's* prow west and sailed to McMurdo Sound, which he reached on Jan. 29. During Feb., stores and equipment were landed and the hut was set up at Cape Royds, Ross Island, and on Feb. 22, the *Nimrod* sailed for New Zealand.

The first of the three important land journeys carried out by Shackleton's expedition, the ascent of the volcano Erebus, was undertaken almost immediately. On March 5, 1908, a party of six, Adams, Brocklehurst, David, Mackay, Marshall and Mawson, started from Cape Royds, and carried out successfully this difficult ascent. There was only one mishap, namely that Brocklehurst's feet were badly frost-bitten, necessitating, later, amputation of one of his big toes. The party reached the summit, 13,370 feet, on March 10, and returned to Cape Royds a couple of days later.

The crater was found to be about 900 feet deep and half a mile wide, and every little while great masses of steam would rush upwards with a loud hissing sound. The most unique feature was the ice fumaroles, of which about fifty were seen. These are ice mounds, resulting from the condensation of vapors around the orifices of ordinary volcanic fumaroles, forming ice structures unknown in any other place in the world, and which could only exist under conditions of very low temperatures.



MOUNT EREBUS AS SEEN FROM WINTER QUARTERS.
Old crater on the left, and active cone rising on the right.

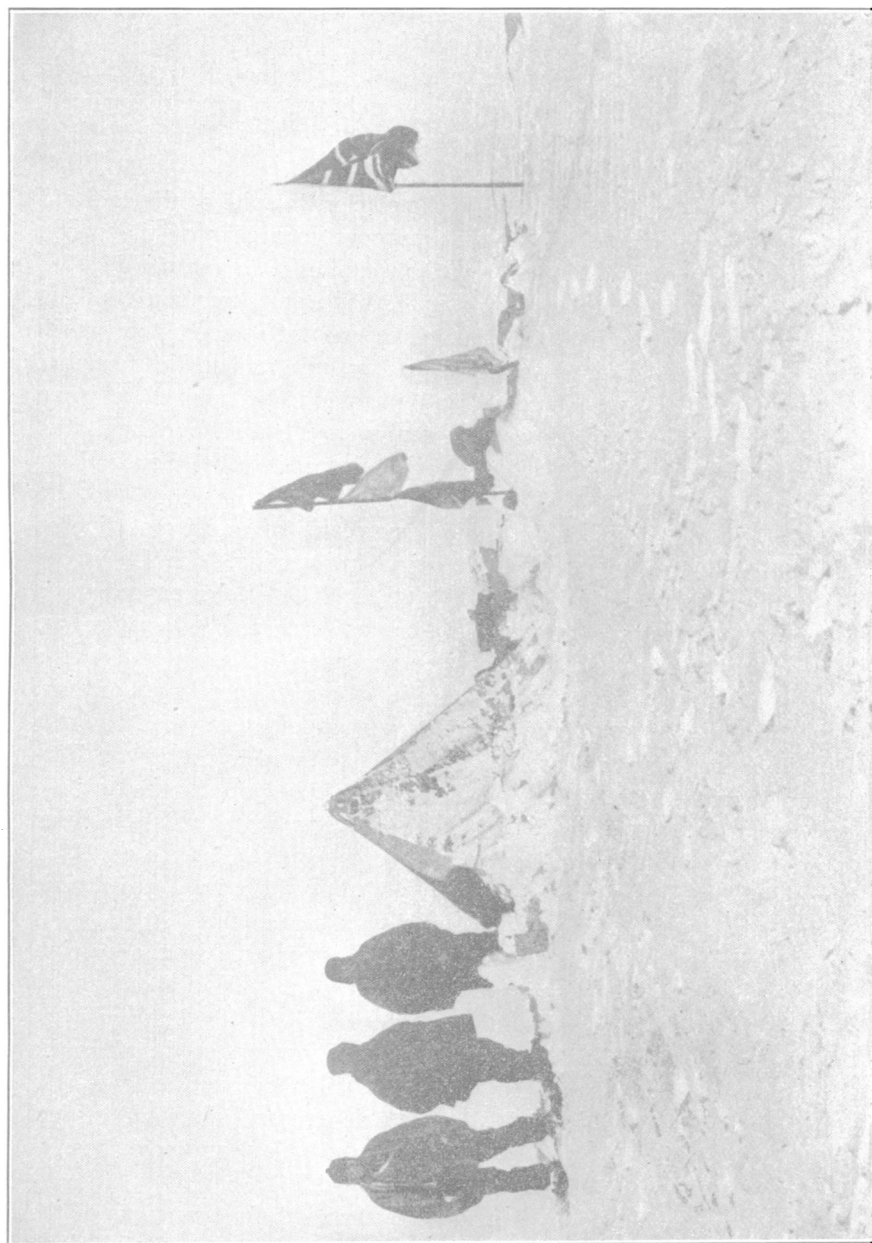
Erebus was steep and icy from bottom to top, the temperature sometimes fell below zero, and there were snow storms and blizzards. Altogether this ascent, by far the highest yet accomplished in Antarctica, must rank among the most difficult of mountain climbs yet made. Erebus is a magnificent mountain. It was watched all through the winter, and every now and then, sometimes at intervals of a quarter of an hour, a strong glow was seen on top. Sometimes great bursts of flame were seen crowning the crater. The column of steam that rises from the crater sometimes rose 3,000 or 4,000 feet before it spread out and was blown horizontally by the upper air currents. The deep red glow occasionally seen on the steam cloud revealed the presence of molten lava in the crater. Altogether there are proofs sufficient to show that Erebus possesses considerable volcanic activity.

The winter was spent in the usual polar manner, taking observations, preparing for sledge journeys, and inventing amusements, such as printing a small book, to pass the time. In September, a preliminary voyage was made to the south, to place depots of stores on the Ice Barrier.

The southern party, consisting of Shackleton, Adams, Marshall and Wild, left the winter quarters on October 29, 1908. They travelled almost due south, at first on the Great Ice Barrier. On this, both going and coming back, they had some trouble with crevasses. On Nov. 26, 1908, they reached $82^{\circ} 18'$ South Lat., just beyond Scott's farthest southern point. New mountain ranges, the continuation of Victoria Land, now began to appear, extending in a south-southeast direction and thereby gradually crossing the direct route to the South Pole. The party kept travelling on the Barrier until Dec. 2, when they were in latitude $83^{\circ} 28'$ S., where the mountains fairly blocked the way directly south.

Here an enormous glacier, stretching almost due south, flanked by huge mountains, and throwing its ice out on the Barrier, fortunately afforded a sort of portal by which the ice cap above could be reached. Up this glacier, afterwards called the Beardmore Glacier, the southern party now forced their way, making one of the most remarkable ascents in the history of mountaineering. Difficulties began at once. Snow slopes changed into blue ice, with numberless crevasses, many of them razor-edged. At $83^{\circ} 40'$ S., a bird, of a brown color, with a white line under each wing, flew past in a southern course. It was not a skua gull. This was the furthest point at which any living thing was seen.

On Dec. 7, they traversed some exceedingly crevassed ice.



THE FURTHEST SOUTH CAMP AFTER SIXTY HOURS' BLIZZARD.

Shackleton, Adams and Marshall were pulling one sledge, and Wild was leading the only remaining pony drawing the other sledge. The first party passed over a hidden crevasse without noticing it, but the greater weight of the pony broke the lid. The pony was swallowed up in the depths of the ice, but fortunately the swingletree snapped, and Wild and the sledge were saved. This was at an altitude of 1,750 feet.

Steady progress was made up the glacier, in spite of the constant danger from crevasses, and the improper foot gear of the party. They were wearing fur boots without spikes. So far nothing has been suggested in the way of suitable boots for mountain climbing in exceedingly low temperatures. The need of some boot in which there are spikes, placed so as not to transmit cold to the feet, has been noticed in the Himalaya and the Antarctic, and there is an opportunity for some inventive genius to devise some new foot covering for use on the highest mountains and in the South Polar regions.

In latitude 85° S., Wild found some seams of coal from 4 inches to 8 feet in thickness, with sandstone intervening. On Christmas day the party were in latitude $85^{\circ} 55'$ S. The glacier proved to be about 130 miles in length, and its top was fairly reached on Dec. 31, at an altitude of 10,477 feet, when the party at last stood on the great ice cap of East Antarctica. The plateau rose gently, however, and on Jan. 3, 1909, they were at an altitude of 11,220 feet.

Food was getting short and rations were steadily cut down. Terrible blizzards swept over the ice cap, the wind sometimes howling along at 80 or 90 miles an hour. The thermometer recorded from 60° to 70° of frost, and on several occasions, the party could do nothing but lie in their bags and let the storm rage past them. Nevertheless these gallant men steadily pushed south.

On Jan. 9, 1909, Shackleton reached his extreme southern point, in latitude $88^{\circ} 23'$ S., longitude 162° E., at an altitude of about 11,600 feet. Here they looked south with powerful glasses, but could see nothing but the dead white snow plain. There was no break in the plateau as it extended toward the Pole, and there can be scarcely a doubt that the South Pole lies in this stupendous plain of ice. Shackleton then hoisted Queen Alexandra's flag, and took possession of the ice in the name of King Edward VII.

The return journey was made almost exactly in the tracks of the outgoing journey, and the food depots were fortunately picked up one by one. It was a long retreat with starvation stalking on their heels. In almost every case they reached each depot with their food

bags empty, and it seems almost a miracle that they ever returned at all. After leaving the plateâu, they descended the Beardmore Glacier to the Ice Barrier, which they followed to the winter quarters on March 1, where they found the *Nimrod* awaiting them.

The latitude observations on the southern journey were taken with a theodolite, the last one being made in $87^{\circ} 27'$ south. The important results of the journey are the discovery of the mountain chain stretching beyond Mount Longstaff towards Alexander Land; the fact that the ice cap of East Antarctica almost surely stretches to the South Pole and probably far beyond it; and the discovery of coal and fossil wood, which sheds some light on the past geological history of the continent of Antarctica.

Simultaneously with Shackleton's southern trip, a journey was made to the north by David, Mackay, and Mawson, on which the South Magnetic Pole was reached. They left Cape Royds on Oct. 5, 1908, and travelled north on the sea ice along the coast as far as the Drygalski Glacier, in about $75^{\circ} 30'$ S. L., which they reached on Nov. 30. The party had neither dogs nor ponies, and so had to drag their two sledges and cover each piece of ground, or rather sea ice, three times. Up to this point they had no particular trouble, although they soon discovered that if they were to reach the South Magnetic Pole, they would have to travel on short rations.

During the next four weeks, the northern party was busy crossing the Drygalski Glacier, and ascending one of its feeders, the Larsen Glacier, to the ice cap of East Antarctica. They only gained 20 miles in these efforts, encountering great difficulties from steep ice ridges and crevasses, and twice failing in attempts to climb to the plateâu, first by the Mount Nansen Glacier and then by the Bellingshausen Glacier. By the end of December, they were fairly through the coastal range, and began to ascend the ice cap.

The party now made a bee line across the ice cap to the South Magnetic Pole. The ice cap rose slowly, from an altitude of 2,800 feet at the head of the Larsen Glacier, to an altitude of 7,350 feet. Soft snow in places, and many sastrugi gave a good deal of trouble, and some blizzards interfered with the travellers. On the whole, however, they made rapid progress, and on Jan. 16, 1909, they reached the South Magnetic Pole, in $72^{\circ} 25'$ S. L., $155^{\circ} 16'$ E. L. As they were only able to stay there a few hours, sufficient observations could not be taken to say that this position is more than approximately correct. They took possession of the South Magnetic Pole for the British Empire, and it may be noted in this connection that the South Magnetic Pole lies almost due south of Wilkes' Cape Hudson.

On Jan. 17, they started back to the coast, following their up tracks. In some places, they put crampons over their finnesko and found them of decided use. The food was running short and sometimes there was trouble with crevasses, but on the whole, they returned with ease, and reached the ocean at Drygalski Glacier on Feb. 3. By great good fortune, the *Nimrod*, which was searching along the coast for the Magnetic Pole party, reached the spot the next day and sighted the explorers' tent. A gun was fired, whereupon the explorers rushed down to meet the ship, and in so doing, Mawson disappeared twenty feet deep into a crevasse and was nearly lost. They were then taken aboard, and the *Nimrod* sailed to Cape Royds to pick up the southern party.

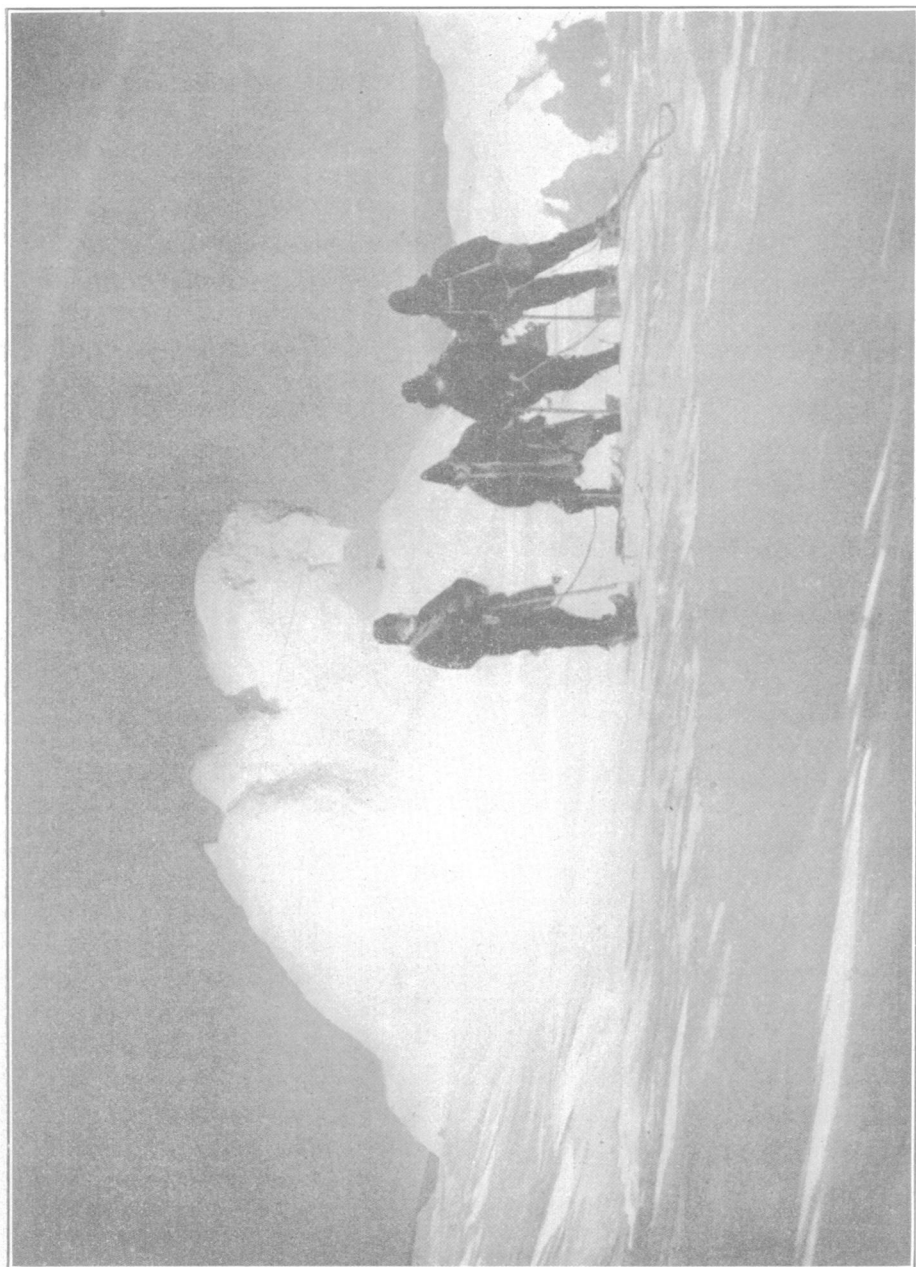
The geographical results of this journey are important. Mawson triangulated the coast of Victoria Land from McMurdo Sound to Drygalski Glacier, and many new peaks, glaciers, ice tongues, and two small islands were discovered. The position reached at the South Magnetic Pole, south latitude $72^{\circ} 25'$, east longitude $155^{\circ} 16'$, shows that the ice cap extends due south of Cape Hudson, and the altitude at the Magnetic Pole, 7,260 feet, implies that the northern coast must be several degrees to the north, almost to a certainty where Admiral Wilkes charted it in 1840.

A journey up the Ferrar Glacier was made from the winter quarters, by Armytage, Brocklehurst and Priestley, between Dec. 9, 1908, and Jan. 25, 1909. On their return, they encamped one night on the sea ice in McMurdo Sound. This broke off from the shore, and they drifted out to sea. Killer whales were spouting around them and occasionally bumping the floe beneath the explorers. By good luck, the wind changed and drifted the explorers back to the shore, on which they were able to jump and thus save themselves from a watery grave.

On March 4, 1909, the *Nimrod* sailed for the north, with all the members of the expedition aboard. They sailed past Cape Adare and to Cape North, where Shackleton wanted to try to push to the westward. The ice, which appears always to be very heavy in this locality, prevented his doing so, but about 45 miles of new coast line, running first south, then west, were visible. Thence the *Nimrod* returned to New Zealand, and afterwards to England, searching, on her home voyage, for Emerald Island, the Nimrod Islands, and Dougherty Island, none of which was found.

Several points, connected with the expedition as a whole, are of interest and of some novelty.

One is the question of clothing. Some Antarctic expeditions,



REMARKABLE FUMAROLE IN THE OLD CRATER IN THE FORM OF A COUCHANT LION,

notably those of Bruce, Nordenskjöld, Scott, and Charcot, largely abandoned the use of fur garments in the Antarctic, preferring woolen clothing with canvas overalls. Shackleton developed this method of dress to the utmost, using furs only for sleeping bags, shoes and mits. His party had pilot cloth coats and trousers, but eventually even these were almost wholly given up. The sledging parties usually wore two or more sets of various sorts of Jaeger woolen undergarments, over which was placed a suit of windproof Burberry canvas. These garments were extremely light in weight and this conduced materially to the speed of travel. To some extent, however, it also conduced to frostbite. Nevertheless Shackleton's verdict is "that men engaged in polar exploration should be clothed as lightly as possible, even if there is danger of frostbite when they halt on the march."

The health of the party was remarkably good throughout the entire expedition. They apparently suffered most from cases of frost-bite when sledging, and this might be used as an argument that the light woolen clothes, with an outer canvas covering, are not those best suited for Polar work. On the southern journey, the party suffered to some extent from dysentery, and this was attributed to eating the meat from one of the ponies, which was shot one night when in a greatly exhausted condition. It seems probable that his flesh was made poisonous by the toxin of exhaustion, which is said to be the case sometimes with animals that have been hunted. The disease called "colds," as is well known, practically owing to the absence of germs, is never experienced in the Polar regions. Shackleton's party, however, had a few colds, and it was thought they were due to germs contained in a bale of blankets.

It is a fact well known to Polar travellers that the main subject of conversation when sledging is food. Shackleton's and David's parties were no exception to this axiom. Both their diaries give abundant proof of it. Shackleton writes: "Feb. 9: All thinking and talking of food." "Feb. 10: All thinking and talking of food." "Feb. 11: All our thoughts are of food," etc., etc. No one, however, has yet described any of these conversations as well as Shackleton has in one passage which deserves to be quoted at length:

"Now we are on board ship," one man would say. "We wake up in a bunk, and the first thing we do is to stretch out our hands to the side of the bunk and get some chocolate, some Garibaldi biscuits and some apples. We eat those in the bunk and then we get up for breakfast. Breakfast will be at 8 o'clock, and we will have porridge, fish, bacon and eggs, cold ham, plum pudding, sweets, fresh roll and butter, marmalade and coffee. At 11 o'clock we will have hot cocoa, open jam tarts, fried cod's roe and slices of heavy plum cake. That will be all

until lunch at 1 o'clock. For lunch we will have Wild roll, shepherd's pie, fresh soda-bread, hot milk, treacle pudding, nuts, raisins and cake. After that we will turn in for a sleep, and we will be called at 3.45, when we will reach out again from the bunks and have doughnuts and sweets. We will get up then and have big cups of hot tea and fresh cake and chocolate creams. Dinner will be at 6, and we will have thick soup, roast beef and Yorkshire pudding, cauliflower, peas, asparagus, plum pudding, fruit, apple-pie with thick cream, scones and butter, port wine, nuts, and almonds and raisins. Then at midnight we will have a really big meal, just before we go to bed. There will be melon, grilled trout and butter-sauce, roast chicken with plenty of livers, a proper salad with eggs and very thick dressing, green peas and new potatoes, a saddle of mutton, fried suet pudding, peaches à la Melba, egg curry, plum pudding and sauce, Welsh rarebit, Queen's pudding, angels on horseback, cream cheese and celery, fruits, nuts, port wine, milk and cocoa. Then we will go to bed and sleep till breakfast time. We will have chocolate and biscuits under our pillows, and if we want anything to eat during the night we will just have to get it."

Probably no one has ever described so well as yet the talk of men on the verge of absolute starvation.

The Manchurian ponies which Shackleton took along proved most valuable as transport animals, probably better than dogs. They would have been even more so, had it not been for their habits of feeding, which resulted in the death of half of them, before they had been of any use. They were fond of eating bits of rope, the tails of the other ponies, in fact anything they could chew or swallow. When first landed, they ate quantities of the volcanic sand of the sea shore, perhaps because it had a saline taste due to the fact that the blizzards sprayed all the land near the shore with sea water. Three of them died from this cause, which could not be explained until a post mortem examination of one of the ponies revealed the fact that his stomach contained many pounds of sand.

Shackleton makes a brief but valuable statement in regard to a matter of much importance in the history of Antarctic discovery. A party one day started off across the ice to visit Inaccessible Island. It proved a much longer jaunt than was expected and Shackleton says that before they returned "they had learned the first lesson of the Antarctic, which is, that distances are very deceptive, and that land is always much more distant than it appears to be."

The scientific and geographic results of the expedition were numerous and valuable.

An important discovery in biology was that made by Murray, on March 13, 1908, that there were living microscopical animals in the fresh water lakes of Antarctica. He obtained gradually a number of these, principally of the varieties known as rotifers and water

bears. They were generally found adhering to small weeds and plants on which they fed. Experiments were tried, which proved that freezing them at the lowest attainable temperatures, did not in the least affect their vitality. Only by subjecting them to tests in liquid air, would it be possible to ascertain what temperature would kill them: in the lowest Antarctic temperature they can live, possibly for many years.

The observations of Professor David and Mr. Priestley have thrown some new light on the geology and glaciology of Antarctica. Their chief conclusions may be summarized as follows:

1. The majority of the tabular bergs of Antarctica are largely, in some cases wholly, snowbergs. True icebergs are also found. The glaciers push out in some cases thirty miles from the coast, and must be afloat for the greater part of this length. Throughout Victoria Land, there is evidence of a recent great diminution in the glaciation. McMurdo Sound was formerly filled by a branch of the Great Ice Barrier, whose surface rose fully 1,000 feet above sea level, and whose entire thickness was about 4,000 feet.

2. Ross Sea is probably a great subsidence area. The Beacon sandstone formation which extends for at least 1,100 miles along Victoria Land contains coniferous wood associated with coal seams and is probably of paleozoic age. Radiolaria, in a fair state of preservation, occur in black cherts among the erratics at Cape Royds, and obscure casts of radiolaria are found in limestones at $85^{\circ} 15'$ S. Lat. These radiolaria appear to be of older paleozoic age. Peat deposits, formed of fungus, are now forming on the bottoms of some of the lakes in 77° and 78° S. Lat. Raised beaches of recent origin extend at Ross Island to a height of at least 160 feet above sea level.

The Great Ice Barrier remains the greatest mystery of the Antarctic, as well as the most interesting problem in the whole field of glaciology. It may be a bay surrounded by mountains, or it may be a strait extending from Ross Sea to Weddell Sea, or from Ross Sea to between Alexander Land and King Edward Land. Some increase of knowledge as to its formation has, at least, been gained. It moves at the rate of about 500 yards annually towards Ross Sea; it calves away in places, as is proved by the disappearance of Scott's Balloon Bight; and these large masses which break off form great tabular bergs. It is fed to some extent from the great glaciers which pour down into it from the mountains, but it seems mainly formed from the accumulation of the snowfall. Messrs. David and Priestley think it consists of true glacier ice at its sides and inland extremity, but that the center and seaward portion is formed, in its

upper part, chiefly of snow. They agree with Captain Scott's conclusions that, except at its edges and perhaps some distance inland, it must be afloat.

Another most interesting Antarctic problem still remaining unsolved is that of the continuation of the mountain range of West Antarctica. This extends from the Shetlands to Alexander Land and is certainly a continuation of the Andes. It may be that this West Antarctica range runs to King Edward Land, or it may be that it runs to Victoria Land. At any rate, the furthest southern mountain ranges seen by Shackleton point in the direction of Alexander Land. The observations of Messrs. David and Priestley led them to think that the coast line of Victoria Land is of an Atlantic rather than of a Pacific type and they conclude "Possibly as Wilckens has suggested, west of Alexander I. Land, the cordillera is submerged through faulting." Dr. Charcot is at present engaged in trying to get further south than Alexander Land, so let us hope he may bring back some further data about this noteworthy problem in physical geography.

A third most important geographical problem in the Antarctic is the coast line of Antarctica. While Shackleton made no special effort to explore any of this, still he accomplished a good deal. He sighted about 45 miles of new coast line, running first a little south, then due west, of Cape North. As this coast has not received a name, I suggest it be christened "Shackleton Land." While Shackleton's southern journey in no wise solves any coastal problem, nevertheless it enlarges so much the known size of the ice-capped plateau of East Antarctica that it much increases the certainty that this plateau must extend, not only to Wilkes Land, but probably also towards Enderby Land and Coats Land, both of which may turn out to be part of the edge of the great ice plateau of East Antarctica.

Shackleton's expedition is certainly one of the most memorable on record. To all intents and purposes, he has solved the problem of the South Pole itself. The next expedition to Ross Sea may get there, but by so doing, will probably add little to knowledge. The greater problems before such an expedition will be to trace the continuation of the Victoria Land mountains and the southern boundaries of the Great Ice Barrier. It will, however, be no small task for anyone to surpass the efforts of Sir Ernest Shackleton, who is evidently not only a great explorer, but a born leader of men.